



Just the Basics: Natural Gas

ENERGY
EFFICIENCY AND
RENEWABLE ENERGY

OFFICE OF
TRANSPORTATION
TECHNOLOGIES



Transportation FOR THE 21ST CENTURY

The fuel that we trust to heat our homes and cook our food has a proven record of excellence as a vehicle fuel, too. Unlike gasoline and diesel fuel, natural gas is inexpensive, domestic supplies of it are abundant, and tailpipe emissions resulting from its use contribute almost no smogforming hydrocarbons. In fact, natural gas is the cleanest burning fuel for vehicles powered by internal combustion engines.

Why natural gas is a valuable resource

Natural gas is a colorless, odorless gas consisting primarily (approx. 90%) of methane. As its name suggests, natural gas derives from plant materials that were transformed over time by geological processes. The resulting gas now lies trapped in underground reservoirs distributed unevenly across the globe. With vast proven reserves in the continental U.S., natural gas is well positioned to serve our transportation energy needs for generations to come.

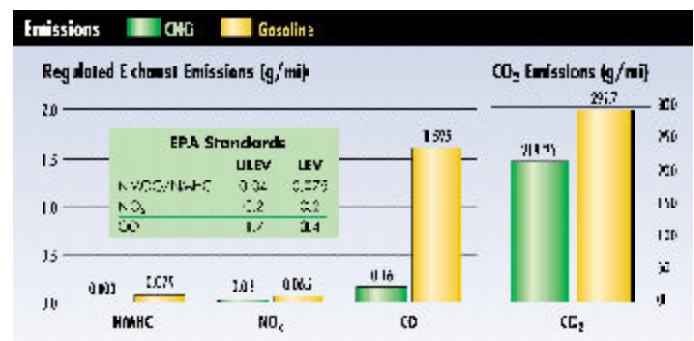
Our supplies of natural gas can help extend the usefulness of gasoline and diesel fuel when used as part of a balanced energy policy aimed at reducing emissions and this nation's dependence on foreign oil through adoption of a range of alternative fuels. The United States now imports more than half of the petroleum it consumes. This amount will surely grow unless alternative transportation fuels such as natural gas can begin replacing petroleum-based fuels in significant quantities.

The clean-burning alternative

Increased use of natural gas as a vehicle fuel promises substantial benefits for the environment. Natural gas burns much more cleanly than gasoline or diesel fuel, thereby drastically reducing harmful tailpipe emissions of carbon monoxide, nitrogen oxides (NOx), non-methane hydrocarbons, and particulate matter. Although natural gas vehicles do release methane, emissions of this relatively unreactive gas are more than offset by a substantial reduction in carbon dioxide emissions. Carbon dioxide is the most important of what are known as greenhouse gases, chemical compounds in the

Earth's atmosphere that trap heat, like a greenhouse, but on a global scale. Too much greenhouse gas in the atmosphere can lead to destructive global warming.

Tailpipes aren't the only places where harmful vehicle emissions can occur. Gasoline vapors are often released while a vehicle is being refueled; gasoline also typically seeps from various components of a vehicle when it is parked. In fact, evaporative and fueling emissions account for at least 50% of a gasoline vehicle's total hydrocarbon emissions. Such emissions are much less likely with natural gas vehicles because the fuel is contained within pressurized fuel systems during fueling and use.



Results from a study conducted by the U.S. Department of Energy, Office of Transportation Technologies, showed greatly reduced emissions in a dedicated natural gas-fueled, 4-cylinder 1998 Honda Civic when compared with those from a comparably equipped, conventional gasoline-fueled Civic.

The versatile transportation fuel

The promise of natural gas as a cost-effective alternative fuel has led to production of an impressive variety of natural gas vehicles. These include passenger cars, pickup trucks, light-duty trucks, delivery vans, shuttle buses, school and transit buses, medium-duty refuse haulers, and heavy-duty semitrailer trucks. Today more than 75,000 natural gas vehicles are operating in the United States and nearly 1 million are in use worldwide. These numbers continue to climb as fleet operators come to recognize the advantages of converting to natural gas. Transit agencies have been particularly active in this regard; consequently, natural gas-fueled buses now account for about 20% of all new bus orders.

Most natural gas vehicles run on compressed natural gas (CNG),

which is typically stored in cylindrical steel tanks at pressures up to 3,600 psi. CNG vehicles have proved to be cost-effective for fleet owners, partially because natural gas is cheaper than other fuels.

On a gallon equivalent basis, natural gas costs



less than gasoline, diesel fuel, or any other alternative fuel. Increasing the price advantage of natural gas is its high 120 octane rating, which permits fleet owners to make engine adjustments that maximize fuel economy. Lower maintenance costs are another factor. Because the fuel burns so cleanly, dedicated natural gas vehicles show significantly less engine wear. Spark plugs also last longer than with gasoline engines, and oil changes are needed less often.

Using liquefied natural gas

Natural gas vehicles running on CNG are often more limited than gasoline vehicles in the amount of fuel they can store, which reduces their driving range. Another limitation is the weight of the fuel tanks, which burdens engine and braking systems.

One way of circumventing these problems is to concentrate the natural gas by cooling it to a temperature of about -260°F, where it changes to the liquid state. Liquefied natural gas (LNG) takes up about 1/600th of the space the gas occupies at room temperature and atmospheric pressure. This means that it can be stored at a relatively low pressure and still provide the greatest possible driving range at a relatively low weight. Also, because LNG is essentially pure methane, it is possible to fine-tune the fuel system and engine, which leads to greater optimization of engine performance and thus greater fuel economy and lower emissions.

LNG tends to be the fuel of choice for medium-

and heavy-duty vehicles whose owners are particularly concerned about low-cost, low-weight fuel storage and extended driving ranges. Ongoing research promises to lead to lighter LNG fuel tanks and further increases in engine efficiency. Technologies also are being developed to produce LNG from unconventional domestic sources. One possibility is landfill gas, which is produced naturally as municipal landfills as refuse decomposes. The amount of potentially recoverable methane from U.S. landfills is estimated to be about 5% of domestic natural gas consumption, or 1% of U.S. total energy needs.

For more information on how DOE is helping America remain competitive in the 21st century, please contact:

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